

IT Strategy for Construction Companies: A Pragmatist's Vision

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Abstract: Leading constructors will alter the economic model in order to take advantage of IT opportunities in the coming years. Strategic business leaders aren't interested in playing with computer tools that nibble at the margins of individual productivity; they seek the substantial savings in costs and improvements in service that have been won in manufacturing, retail, and financial services industries. These victories are achieved by using the power of technology to streamline and improve entire supply chains; not just to automate processes within the walls of one firm. The construction industry is currently organized on an "every man for himself" business basis: each firm holds its information within its walls. Therefore, the compelling IT strategies in construction and engineering will incorporate economic incentives that overcome this barrier and make it worthwhile for individual actors to aid the whole supply chain. What are these tools? How might the incentives be structured? The marriage of technology tools and business incentives is the core of a strategic vision for information technology in construction for the next decade.

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Fragmentation and Individual Actors

The global construction industry is highly fragmented. Even large firms like Bechtel and Skanska command less than ½ of 1% of this \$US 4 trillion market. In the United States, the ENR 400 combined have about \$US 150 bn in revenue, or in aggregate less than 25% of the \$850 bn US market (ENR statistics). There is no large player who can drive the industry, no "channel master" like General Motors, Boeing, Wal-Mart, or Fidelity in other manufacturing or service industries.

Why is this? Because construction is a locally oriented industry, executed on a project by project basis, with a unique output that is not transportable. There are low barriers to entry and, so far, very few economies of scale. The factors limiting growth are capital, project management skill, and face to face selling capacity; none of which are easy to scale up.

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Layer upon this a compensation system of hundreds of lump sum contracts that define the total contract structure of every project – for example the lump sum contract between the general contractor and the excavation firm – and one can see why the industry remains fragmented. Each firm has compelling economic reasons to look out for its own interests first. In the prevailing context of litigation and high risk, firms can be observed to act against the overall benefit of “the system” in order to protect their own interests. Examples are abundant. One is an architect’s reluctance to share digital designs that help contractors to do estimates. Another is a ductwork installer’s unwillingness to alter its optimal installation sequence at a cost of two man days even if all agree that this would save the electrician four man days. There is no vehicle to reward the parties for total system thinking.

Status of IT today.

Understandably, IT progress to date has largely been in automating processes within single companies – for example accounting, project control, drafting, wireless communication. These can be controlled within the firm and the return on investment can be calculated with respect to the firm alone.

This means that the information technology strategies that have transformed other industries have passed by the global real estate and construction industries. Examples include Dell Computer in cutting out intermediaries in retail computer sales; Wal-Mart in realizing overwhelming cost advantages in supply chain optimization; or Fidelity Investments in realizing scale and service advantages that first opened up mutual fund investing to individuals on a retail basis, and then built scale in processing, research, and costs of funds that is difficult to surmount. How can these finally arrive in construction, the largest industry in the world?

How Information Gives You Competitive Advantage

In 1985, Michael Porter of the Harvard Business School proposed that information can give you competitive advantage in one of three ways: 1) increase your revenue, 2) reduce your costs, or 3) restructure the competitive playing field. Many of the most “neat and wonderful” technologies are (allegedly) justified in the first category. For example, 3D visualization and its cousin, 4D modeling, can help construction companies to differentiate themselves at the interview. But it’s far from clear that they are a) defensible intellectual property or b) that they can impact cost in a significant way.

Cost reduction technologies include productivity and planning tools like Primavera Project Planner or Meridien Prolog. But they just help a few individuals to go faster; they don’t tend to optimize the system. One could even argue that they work against optimizing the whole contract system; both tools are still marketed for claims control and litigation support, adding the manipulation of information to the already formidable “me vs. you” arsenal in the industry.

Obstacles

Admirers of IT strategy in other industries note many opportunities for this industry. Among the most promising are:

- Supply Chain Optimization
- 3D Solid Modeling tied to Databases
- Knowledge Management

What are the obstacles to implementation of these tools? Some include setup cost. It is much harder to support a design firm that needs a current kit of 3D components for all elements than it is to simply clip 2D sections from a details book and paste them onto mylars. Others obstacles include lack of scale. Wal-Mart, Fidelity, and FedEx didn't truly have barriers to entry built until they had achieved the size to amortize new investments in technology and to offer true large scale procurement opportunities. A third is compensation. If an innovative contractor is working for an innovative owner, the contract is likely to be based on some sort of cost of work, open book payment method. Any savings get passed on to the Owner. Where's the financial incentive for big time innovation? (Macomber, 2003).

Finally and most importantly, these potentially transformational technologies assume that the parties want to share information and to optimize results. From a purist systems engineering point of view, maybe. But from a business point of view, this is just not so. Hard experience shows that rational economic actors say over and over again, "I'm glad that you have technology that allows me to share my information with the team. But until I am paid to share (or at least not further exposed by sharing), why should I share?"

This phenomenon leads to frustration among vendors, hand wringing among academics and technology lovers, and exasperation among "total system thinkers."

I'll Make it Worth Your While: A Vision for Sharing

A pragmatist's strategic vision for information technology in the construction industry must solve the economic issues. The vision articulated below uses a simple example of one component of a building, and one technology, to set out an idea for how this goal might be achieved.

Take the example of supply chain optimization technology. Take the example of a building for an Owner who has intense pressures to get open as fast as possible so that manufacturing can come on line – with its associated revenue streams. Take the sole example of the emergency generators – a high value added, long lead item that is also on the critical path. To further highlight the economic issues, assume that in the baseline case the Owner is paying significant sums in overtime and expediting in order to accelerate construction. Thoughtful supply chain management can eliminate or reduce these costs.

How is Expedited Procurement Accomplished Today?

The generators are specified based primarily on capacity required by the electrical demand of the building. There is no reason, or opportunity, for the designer to see what sizes actually might be available in the manufacturing queue; or even to see what else is being specified for the same owner.

Many months later, the electrical subcontractor goes to purchase the specified generator. They are buying a quantity of one for the building. The manufacturer quotes a price based upon a markup on its cost to make one copy. This has manufacturing inefficiencies in scheduling, in setup time, and in procuring components. The manufacturer quotes 16 weeks for delivery – a big problem in the critical path.

What happens? To expedite the job, the Owner and the contractor a) negotiate a substitution that can arrive faster (now without any negotiating leverage), b) pay to expedite at the plant (again without leverage) and c) work overtime in the field later in the project, making up time with the multiple trades who were set back in their schedule. This could now involve hundreds of craftspeople.

Clearly this is not effective from the point of view of lowering total system cost.

Taking Time out of the System: Design to Availability

Now imagine a vision where the designer has real time access to cost and delivery information at the time of specifying the component. Maybe they even can commit it. Perhaps an available generator is 10% too large. So what, if it can be delivered months sooner, and maybe at a lesser cost since the manufacturer already has these units set up to run in the production line? This is the kind of information that Dell uses when a buyer logs on to purchase a computer: the buyer can configure the order to react to what components are available, now.

Picture the manufacturing end. There is little visibility into demand; manufacturers now rely on McGraw Hill and Reed Construction Data (formerly CMD Group) for forecasts of need, based on sources like architect interviews and building permit applications. There is no opportunity for manufacturers to arrange the shop floor for long runs of the same model, saving setup costs, procurement costs, and labor costs. And there is no mechanism to help customers to buy better, even if the buyers wanted to.

The conceptual answer: Provide benefits like “design to availability” for the Owner (and the Owner’s agents, like designers; and provide benefits like “visibility into demand” for manufacturers. Firms like i2 Technologies, Oracle, and IBM provide the software that can track, communicate, and optimize the whole system from both ends.

The clear benefit: Costs taken out of the system for: Manufacturing; procurement of component parts; expediting; substitution; and overtime.

For example

The tables below show a hypothetical structure for embarking on this analysis. Of course it is oversimplified – but it's a starting point. The many components of cost paid by the Owner can be seen filtering through the supply chain.

Owner:

Equip Cost paid to GC		\$ 67,980
Premium for OT		20,000
Premium to expedite		<u>2,500</u>
Paid this item and related		90,480

GC:

Revenue from Owner @	103%	\$ 67,980
Cost paid to Sub		<u>66,000</u>
Contribution this item		1,980

Subcontractor:

Revenue from GC @	110%	66,000
Cost paid to Manufacturer		<u>60,000</u>
Contribution this item		6,000
Net Margin on OT	10%	<u>2,000</u>
Total to Sub		8,000

Manufacturer:

Base Revenue from Sub @	120%	60,000
Cost to Manufacture		<u>50,000</u>
Contribution		10,000
Margin from Expediting @	5%	<u>2,500</u>
Total Margin		12,500

In this example, the Owner pays \$90,480 to purchase, install, and expedite this piece of equipment. The Manufacturer realizes \$12,500 contribution after the costs of manufacture and of expediting.

How Can This Equation Be Improved?

In the table below, three key items change thanks to design to availability and visibility into demand. First, the premium for overtime on the site is eliminated. Second, the cost to manufacture is reduced significantly. Third, the cost to expedite is eliminated thanks to the ability to specify and purchase a model variation which is available, rather than the one that perfectly matches the design load. The cost to the Owner now is just \$54,384.

At first blush, this of course saves the Owner money. *But it costs the Manufacturer.* Manufacturing cost drops 20% and margin falls, too. *Why would a manufacturer want to share the savings?*

This is why the “optimization pool” is a business necessity. “The System” (headed by the Owner) *distributes part of the savings*, thereby improving the margin of all firms and sharing the benefit.

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<u>Per Firm, with Savings from Efficiencies:</u>				
		<u>Old</u>	<u>Savings</u>	<u>Efficient</u>
Owner:				
Equip Cost paid to GC		\$ 67,980		\$ 54,384
Premium for OT		20,000	(20,000)	0
Premium to expedite		<u>2,500</u>		<u>0</u>
Paid this item and related		90,480		54,384
GC:				
Revenue from Owner @	103%	\$ 67,980		\$ 54,384
Cost paid to Sub		<u>66,000</u>		<u>52,800</u>
Contribution this item		1,980		1,584
Subcontractor:				
Revenue from GC @	110%	66,000		52,800
Cost paid to Manufacturer		<u>60,000</u>		<u>48,000</u>
Contribution this item		6,000		4,800
Net Margin on OT	10%	<u>2,000</u>		<u>0</u>
Total to Sub		8,000		4,800
Manufacturer:				
Base Revenue from Sub @	120%	60,000		48,000
Cost to Manufacture		<u>50,000</u>	(10,000)	<u>40,000</u>
Contribution		10,000		8,000
Margin from Expediting @	5%	<u>2,500</u>	(2,500)	<u>0</u>
Total Margin		12,500		8,000
<i>At first blush, finding efficiencies HURTS the margins of all firms.</i>				

<u>Summary of All, with Optimization Pool (single project):</u>		
	<u>Old</u>	<u>Optimized</u>
Owner pays for this item	90,480	54,384
<i>Owner funds optimization pool</i>	<u>0</u>	<u>17,000</u>
Owner Total	90,480	71,384
Owner saves		<u>\$ 19,096</u>
Margins in Supply Chain		
GC Baseline	1,980	1,584
GC with Optimization Pool	<u>0</u>	<u>1,000</u>
Subtotal	1,980	2,584
Designer Baseline	5,000	5,000
Designer with Optimiz'n Pool	<u>0</u>	<u>1,000</u>
Subtotal	5,000	6,000
Sub Baseline	8,000	4,800
Sub with Optimization Pool	<u>0</u>	<u>5,000</u>
Subtotal	8,000	9,800
Manufacturer Baseline	12,500	8,000
Manuf with Optimiz'n Pool	<u>0</u>	<u>10,000</u>
Subtotal	12,500	18,000
Total Margins to All	27,480	36,384
Margins <i>improve</i> by:		\$ 8,904

In this example, *the Owner still saves \$19,000; and the aggregate margins of all the other players improve by \$8,904* compared to the old way. Where does this seemingly impossible benefit come from? As it has at Dell, Ford, Wal-Mart and Citigroup: Through thoughtful optimization to take out inefficiencies in production costs, in overtime, and in expediting. The key actors benefit by working with each other.

A Vision of Aggregation

The illustration is of course for one project, with exaggerated numbers to make the point.

But the savings are not possible for just one project. Even in the best of circumstances, the purchase of one generator from one vendor is not going to warrant the effort to try any clever gain sharing or optimization efforts.

Now assume that there are 20 buildings in four geographic regions for five owners, being built by five general contractors and seven different electrical subcontractors, and procuring emergency generators from two sources. Assume there is an existing market maker to

coordinate the demand and supply from these disparate firms. Now there is scale. Now the setup costs to figure out the system are complete. Ultimately, these owners are buying from these building products manufacturers. With a proven system of visibility and reward, and with a potential buy of dozens of generators, it gets interesting.

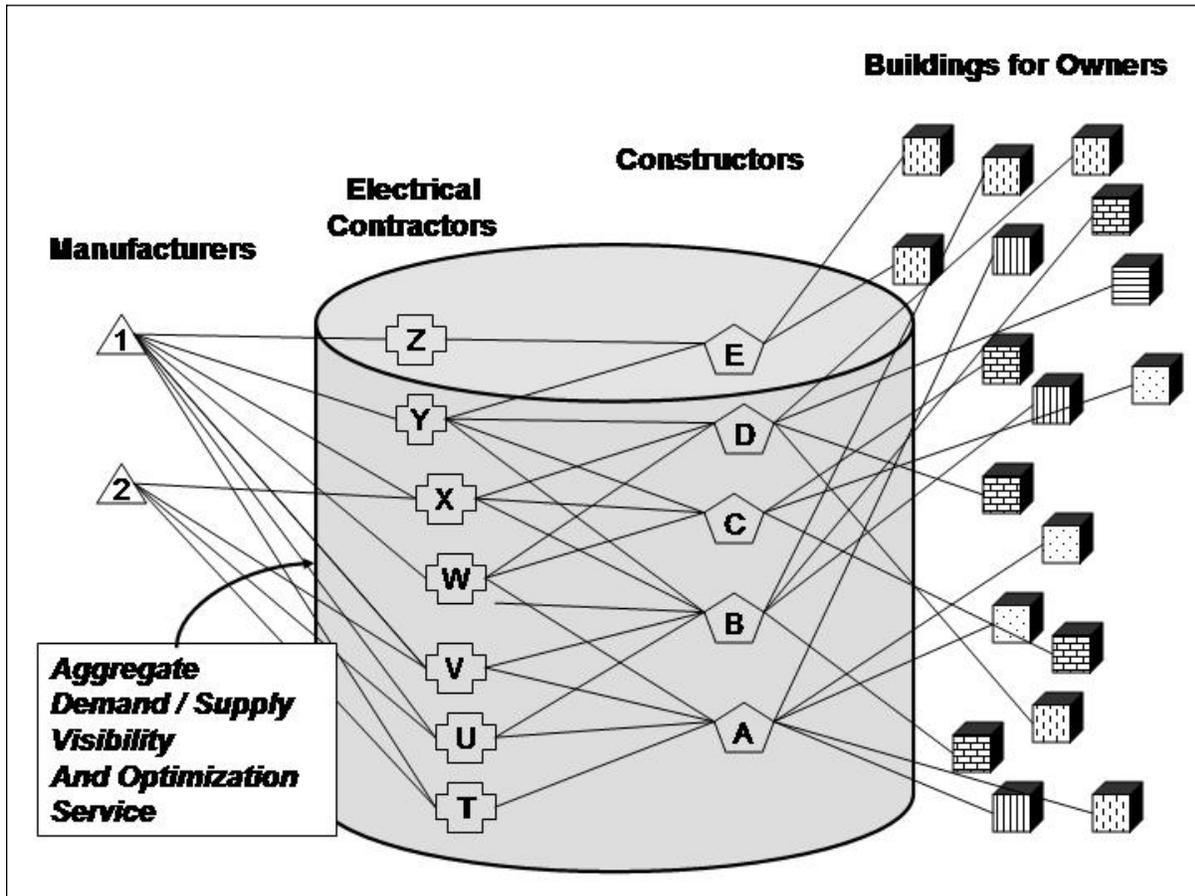


Fig 1. Service to Aggregate Demand and Supply Visibility Across Multiple Projects

Implementation

This seems like an obvious IT strategy winner.

Why won't it happen? Because no actor is large enough to drive it. There is no channel master – not even large construction buyers like General Motors or Procter & Gamble are big enough to drive this. And in the industrial sector, a firm like General Motors may spend \$1 bn per year on construction (ENR) – but the total assets and the total revenues of General Motors approach \$200 bn, and their first concerns are automobile revenue, cost of manufacturing, cost of funds, R&D, and personnel. There isn't the justification for owners to invest in a supply chain strategy for facilities.

Perhaps a large construction firm will be able to do it. Is any firm big enough to aggregate this many projects, and to be trusted by this many players? How much will the leaders want to embrace potentially disruptive technologies that might undermine the skills that got them big in the first place? What if these skills include old fashioned bulk procurement, competitive success at protecting information, and an ability to serve Owners on a cost pass-through basis where risk is minimized and where innovation is not rewarded economically?

More likely, a thoughtful alliance of firms will take the lead and reap the benefit – similar to the banks that make up Visa and Mastercard, or the franchise allies at McDonalds or the National Football League.

What else is needed? A trusted coordinator – the famed “honest broker” of dot.com fame – to make this work. Is there a precedent? Certainly. Examples include Lloyds of London, EBay and the New York Stock Exchange. Even in construction, financial engineering thinking can prove remarkably efficient at sharing and allocating risk among firms with excess bonding capacity, matching them with firms who seek bonding capacity, all working within the constraints of an established surety marketplace.

A Pragmatist's Vision: Possibility, Payment, and Pooling

This paper has outlined several existing obstacles to compelling IT strategies for construction companies. It has also proposed a vision, in exaggerated form, of how just one technology might be adopted for the benefit of many parties. A pragmatist sees that the economic issues must be solved – and then the technology issues will follow.

- Information Technology strategy to date has been limited to the confines of individual firms.
- To unlock the capability for firms to share information and optimize the total system, a method for providing economic incentives must be established.
- One possibility is for very large firms to become the “channel master” and lead this business effort.
- Another possibility is for alliances of firms to pool resources – and to pool information about demand and supply up and down the supply chain – to figure out the model.

Once the players are compensated for sharing cost and schedule information, they will quickly embrace other technologies that benefit the whole team more than they benefit individuals – for example, knowledge management, 3D CAD tied to cost databases, or 4D CAD.

In this manner, pragmatic and visionary construction companies will be able to finally realize sustainable competitive advantage from information technology.

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References:

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